Egyptian Journal of Ear, Nose, Throat and Allied Sciences (2015) **16**, 35–40

HOSTED BY

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Egyptian Journal of Ear, Nose, Throat and Allied Sciences

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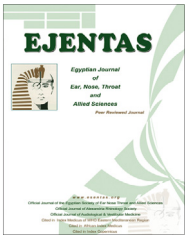

ORIGINAL ARTICLE

Prevalence of group A β-haemolytic *Streptococcus* among children with pharyngitis in Jimma town, Southwest Ethiopia

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Received 2 January 2015; accepted 4 February 2015
Available online 5 March 2015

KEYWORDS

Group A *Streptococcus*;
Pharyngitis;
Children;
Clinical predictors;
Ethiopia

Abstract *Background:* Group A *Streptococcus* (GAS) is an important cause of morbidity and mortality among children and responsible for 20–30% of bacterial pharyngitis.

Objective: Determining prevalence, antimicrobial susceptibility pattern and clinical predictors of GAS among children with pharyngitis.

Method: A cross sectional study was conducted on 355 children with pharyngitis attended in Health Centers of Jimma town from May 8 to December 31, 2013. Demographic and clinical data were collected by questionnaire. Throat swabs were collected and processed with the standard microbiological techniques to isolate GAS. The disc diffusion method was used for antimicrobial susceptibility testing. Descriptive statistics and multivariate logistic regression analysis were done by SPSS version 20.

Results: Females accounted for 57.7% of 355 children with pharyngitis. Sixty-six percent of the children were 5–9 years old giving mean ± SD age of 8.5 ± 2.7 years. The prevalence of GAS was 11.3%. All isolates of GAS were susceptible to penicillin and erythromycin. However, 52.5% were resistant to tetracycline. Absence of cough, tonsillar swelling or exudate and temperature > 38 °C were found to be independent predictors for GAS infection among children with pharyngitis ($P < 0.05$).

Conclusion: In this study the prevalence of GAS was relatively low. However, the seasonality of GAS infection might underestimate the prevalence, so that large-scale prospective study in the entire season and in various settings is required. In addition, the clinical variables that are predictor of GAS pharyngitis can be considered for the diagnosis of GAS pharyngitis with further evaluation of its reproducibility in different settings.

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Peer review under responsibility of Egyptian Society of Ear, Nose, Throat and Allied Sciences.

http://dx.doi.org/10.1016/j.ejenta.2015.02.001

1. Introduction

Group A *Streptococcus* (GAS) is a Gram positive spherical bacterium that causes different spectrum of human infections, ranging from pharyngitis and pyoderma, to life threatening immunological complications such as acute rheumatic fever (ARF), rheumatic heart disease (RHD), post streptococcal glomerulonephritis (PSGN), toxic shock syndrome (TSS) and necrotizing fasciitis.[1,2]

Globally, it is estimated that about 600 million cases of symptomatic GAS pharyngitis occur annually among people aged over 4 years and over 550 million of these occur in less developed countries. The greatest global burden of GAS disease is due to RHD which follows GAS pharyngitis, where 15 million cases and 349,000 deaths occur worldwide annually. Ninety-five percent of the disease burden from RHD is in low and middle income countries where it continues to have a significant impact on the health of children and young adults. There are 2.4 million affected children between 5 and 14 years of age in developing countries, 1 million of whom live in Sub-Saharan Africa, making the continent the major ARF/RHD hotspot.[3–5]

Ethiopia as one of the African countries shares the burden of ARF. Accordingly, 50–64% of heart disease among children was reported to be of rheumatic origin.[6] Similarly, the rate of RHD among cardiac admission in Ethio-Swedish Children's Hospital was 54.5%.[7] It is also documented that the prevalence of RHD among Ethiopian cardiac patients in Addis Ababa city and Jimma town was 39.6% and 32.8%, respectively.[8,9]

Despite the high burden of GAS pharyngitis and its severe immunological sequelae, much is not done on epidemiology, antimicrobial susceptibility pattern and clinical information regarding the disease. Therefore, the aim of this study was to determine the prevalence, antimicrobial susceptibility pattern and clinical predictors of GAS among children with pharyngitis.

2. Materials and methods

2.1. Study participants

A cross sectional study was conducted on 355 children aged 5–15 years with pharyngitis presenting at two Health Centers in Jimma town from May to December 2013. Children who were on antibiotic treatment or who had taken antibiotics within 7 days before sample collection were excluded from the study. Patients' demographic and clinical information were collected using a structured questionnaire by trained health officers.

2.2. Collection, transportation and processing of throat swab

Trained health officers collected the throat samples from posterior pharynx and tonsils using sterile cotton swabs. Necessary care was taken not to swab the cheeks, tongues, lips or other areas of the mouth. The swabs were placed immediately in Amies transport medium (Oxoid, England) and transported to Jimma University Microbiology Laboratory and processed within 2 hours of collection.[10,11]

Then, the throat swabs were inoculated onto 5% sheep's blood agar plates and incubated for 24 h at 37 °C in a candle jar, which can provide an atmosphere of 5% CO_2. Culture plates negative for β-haemolytic colonies were incubated for additional 24 hours to allow the growth of slow growers. Identification of GAS isolates was made based on the standard microbiological techniques which include β-haemolytic activity on sheep's blood agar, small colony characteristics, Gram positive cocci , catalase production negative, 0.04-U bacitracin disc susceptibe and PYR positive (Hardy Diagnostics, USA) tests.[10,12]

Table 1 The prevalence of GAS with respect to socio demographic characteristics among children with pharyngitis in Jimma town, Southwest Ethiopia from May to December 2013.

Characteristics		Culture result for GAS		Total No. (%)
		Negative No. (%)	Positive No. (%)	
Sex	Male	134 (89.3)	16 (10.7)	150 (42.3)
	Female	181 (88.3)	24 (11.7)	205 (57.7)
Age in years	5–9	212 (90.2)	23 (9.8)	235 (66.2)
	10–15	103 (85.8)	17 (14.2)	120 (33.8)
Residence	Urban	294 (89.1)	36 (10.9)	330 (93.0)
	Rural	21 (84.0)	4 (16.0)	25 (7.0)
Schooling[a] status	Yes	290 (87.9)	40 (12.1)	330 (93.0)
	No	25 (100.0)	0 (0.0)	25 (7.0)
Educational status of the family[b]	Illiterate	45 (84.9)	8 (15.1)	53 (14.9)
	Read & Write	16 (100.0)	0 (0.0)	16 (4.5)
	1–4 grade	42 (95.5)	2 (4.5)	44 (12.4)
	5–8 grade	79 (87.8)	11 (12.2)	90 (25.4)
	9–12 grade	89 (89.0)	11 (11.0)	100 (28.2)
	>12 grade	44 (84.6)	8 (15.4)	52 (14.6)
Family[b] income per month (USD)	⩽25	109 (85.2)	19 (14.8)	128 (36.1)
	26–50	120 (93.8)	8 (6.2)	128 (36.1)
	⩾50	86 (86.9)	13 (13.1)	99 (27.9)
Total		315 (88.7)	40 (11.3)	355 (100.0)

[a] *Schooling*: current schooling status of the children.
[b] *Family*: Mother, Father or Guardian.

2.3. Antimicrobial susceptibility testing

Antimicrobial susceptibility testing was done by using the disc diffusion method according to criteria set by Clinical Laboratory and Standard Institute (CLSI) and European Committee of Antimicrobial Susceptibility Testing (EUCAST). The pure colony of GAS bacterial suspension from brain heart infusion broth (BHI) was evenly spread onto Muller Hinton agar supplemented with 5% sheep blood using sterile cotton swab. Soon after, antibiotic discs were placed on the inoculated plate and the plates were incubated at 37 °C in a candle jar overnight. The following antimicrobial discs with respective concentration were used: penicillin (1 unit), ceftriaxone (30 μg) and chloramphenicol (30 μg) all from [Becton Deckinson BD, USA Company], amoxicillin (25 μg), erythromycin (15 μg), clindamycin (2 μg), tetracycline (30 μg) all from [Oxoid, England]. The antibiotic discs were selected based on prescription pattern and recommendations from CLSI and EUCAST. Zone of inhibition diameters were interpreted as sensitive, intermediate and resistant according to the principles established by CLSI and EUCAST.[13,14]

2.4. Statistical analysis

Statistical analysis was done by SPSS version 20 statistical software. Participants' demographic and clinical characteristic were described by using descriptive statistics. Bivariate and multivariate logistic regression analysis were done to identify the clinical predictors for GAS pharyngitis and *P*-value less than 0.05 taken as statistically significant at 95% confidence level.

2.5. Ethical consideration

Ethical clearance was obtained from Jimma University Ethical Review Board. Prior to recruitment of study participants, letter of permission and written informed consent were secured from the health facility managements and the parents/caregivers/ respectively. The purpose of the study was clearly described to the study participants and confidentiality was kept.

3. Results

3.1. Socio-demographic characteristics and prevalence of GAS

A total of, 355 children between ages of 5 and 15 years with pharyngitis were enrolled from May 8 to December 31, 2013. Females accounted for 57.7% and urban residents were 93.0%. Sixty-six percent of the children were 5–9 years old with mean ± SD age of 8.5 ± 2.7. Moreover, the average family size of the target population was 4.6 with mean of 1.8 children less than 15 years per household (Table 1).

In this study, the overall prevalence of group A *Streptococcus* (GAS) was 11.3% (40/355). The prevalence of GAS in females was 11.7%, in children aged 10–15 years 14.2%, among rural residents 16% and in children with family income ⩽25 USD/month 14.8% (Table 1).

Sixty-three percent of children had an episode of sore throat of which 27 (12.1%) were culture positive for GAS. About 33.5% of study participant children experienced single episode of sore throat in the previous year of which 14.7% became culture positive for GAS. Similarly, 11.2% of the

Table 2 The prevalence of GAS in relation to medical and treatment history of children with pharyngitis in Jimma town, Southwest Ethiopia from May to December 2013.

Medical and treatment history		Culture result for GAS		Total No. (%)
		Negative No. (%)	Positive No. (%)	
Sore throat episode in previous year	Yes	197 (87.9)	27 (12.1)	224 (63.1)
	No	118 (90.1)	13 (9.9)	131 (36.9)
Total		315 (88.7)	40 (11.3)	355 (100.0)
Recurrent sore throat episode in the previous year	1-Times	64 (85.3)	11 (14.7)	75 (33.5)
	2-Times	58 (93.5)	4 (6.5)	62 (27.7)
	3-Times	34 (87.2)	5 (12.8)	39 (17.4)
	4-Times	22 (95.7)	1 (4.3)	23 (10.3)
	5-Times	19 (76.0)	6 (24.0)	25 (11.2)
Total		197 (87.9)	27 (12.1)	224 (100.0)
Treatment measure for the episode taken	Yes	188 (87.4)	27 (12.6)	215 (96.0)
	No	9 (100.0)	0 (0.0)	9 (4.0)
Total		197 (87.9)	27 (12.1)	224 (100)
Place treatment measure taken	Clinic	178 (87.7)	25 (12.3)	203 (94.4)
	Traditional Healer	10 (83.3)	2 (16.7)	12 (5.6)
Total		188 (87.4)	27 (12.6)	215 (100.0)
Uvulectomy	Yes	10 (90.9)	1 (9.1)	11 (3.1)
	No	305 (88.7)	39 (11.3)	344 (96.9)
Total		315 (88.7)	40 (11.3)	355 (100.0)
Duration of symptom for the current sore throat in days	1–2 days	171 (87.7)	24 (12.3)	195 (54.9)
	3–4 days	114 (90.5)	12 (9.5)	126 (35.5)
	⩾5 days	30 (88.2)	4 (11.8)	34 (9.6)
Total		315 (88.7)	40 (11.3)	355 (100.0)

Table 3 Bivariate and multivariate logistic regression analysis of clinical predictors of GAS among children with pharyngitis in Jimma town, Southwest Ethiopia from May to December 2013.

Clinical signs and symptoms		Crude OR (95% CI[a])	*P*-value	Adjusted OR[b] (95% CI)	*P*-value
Cough	Yes	1.00		1.00	
	No	3.608 (1.740–7.480)	0.001	3.778 (1.735–8.225)	0.001
Tonsillar swelling or exudate	Yes	4.605 (1.757–12.074)	0.002	4.482 (1.631–12.314)	0.004
	No	1.00		1.00	
Body Temperature	>38 °C	3.275 (1.645–6.520)	0.001	3.479 (1.616–7.490)	0.001
	⩽38 °C	1.00		1.00	
Enlarged anterior cervical lymph node	Yes	0.955 (0.494–1.845)	0.891	2.060 (0.983–4.316)	0.056
	No	1.00		1.00	
Drooling	Yes	2.015 (0.821–4.947)	0.126	2.364 (0.864–6.471)	0.094
	No	1.00		1.00	
Rhinorrhea	Yes	1.00		1.00	
	No	3.416 (0.797–14.631)	0.098	3.870 (0.826–18.139)	0.086
Dysphagia	Yes	0.635 (0.284–1.415)	0.266		
	No	1.00			
Hoarseness	Yes	0.715 (0.327–1.561)	0.399		
	No	1.00			
Abdominal pain	Yes	1.00	0.446		
	No	0.762 (0.378–1.533)			
Nausea	Yes	1.169 (0.604–2.264)	0.643		
	No	1.00			
Vomiting	Yes	0.949 (0.477–1.891)	0.883		
	No	1.00			
Otitis media	Yes	1.107 (0.408–3.007)	0.842		
	No	1.00			
Petechia on the palate	Yes	1.073 (0.396–2.911)	0.889		
	No	1.00			
Conjunctivitis	Yes	1.00	0.318		
	No	0.619 (0.241–1.589)			

[a] CI = Confidence Interval.
[b] OR = Odds Ratio.

children had five times recurrent episodes of sore throat which 24% were culture positive for GAS (Table 2).

3.2. Antimicrobial susceptibility pattern of GAS isolates

The antimicrobial drug susceptibility profile showed that all GAS isolates were susceptible to penicillin G, amoxicillin, erythromycin, clindamycin, chloramphenicol and ceftriaxone. However, more than 52% of those isolates were resistant to tetracycline.

3.3. Clinical predictors for GAS pharyngitis in children

The bivariate logistic regression analysis was done to identify clinical signs and symptom predictors for throat culture. Accordingly, cough, tonsillar swelling or exudate, temperature >38 °C, drooling and rhinorrhea revealed statistically relevant value ($P < 0.25$) to be considered for multivariate analysis. All clinical predictors not showing *P*-value of <0.25 were removed from the multivariate analysis. However, enlarged anterior cervical lymph node due to its clinical importance was included in the multivariate analysis. Accordingly, the three clinical variables including absence of cough [AOR 3.77, 95% CI 1.73–8.22, $P = 0.001$], tonsillar swelling or exudate [AOR 4.48, 95% CI 1.63–12.31, $P = 0.004$] and temperature >38 °C [AOR 3.47, 95% CI 1.61–7.49, $P = 0.001$] were found to be independent predictors for GAS pharyngitis in children (Table 3).

4. Discussion

Group A *Streptococcus* (GAS) is the most common bacterial cause of acute pharyngitis, responsible for 20–30% of sore throat in children.[15] The overall prevalence of 11.3% GAS detected in our study was comparable with 11% reported in Turkey,[16] 12% in Brazil[17] and 9.7% among healthy school children in Ethiopia.[18] But, it was much higher than the prevalence of 2.8%, 4.1% and 7.9%, in India,[19] Taiwan[20] and Indonesia[21] respectively.

On the other hand, the 11.3% prevalence of GAS in our study was much lower than 40.6% reported in Ethiopia.[6] This low prevalence of GAS in the current study may be due to a difference in seasons where the previous study in Ethiopia was conducted from February to May when the carriage rate and infection of GAS reached the maximum. Moreover, civil war during 1992 in Ethiopia may have contributed to an influx of people to the big cities causing crowding and lower standards of living which might be the reason for observed high prevalence of GAS in the former study.[6] In addition to this, the low prevalence rate in our study is probably due to the trends of over prescription of antibiotics in health facilities as it was demonstrated in our data where 100% of children with pharyngitis received either amoxicillin or penicillin. Such indiscriminate use of antibiotics might contribute for the low carriage rate of GAS in the community. Similarly, 11.3% prevalence of GAS in our study was lower

than the findings in Egypt,[22] Tunisia,[23] Yemen,[24] Brazil[25]and USA[26] where average prevalence of 17–58% was reported. Such variation may be due to differences in methodology, seasons of sample collection and geographical variation of study settings.

In this study, all GAS isolates were susceptible to penicillin, amoxicillin, erythromycin, clindamycin, chloramphenicol and ceftriaxone, which go in agreement with previous studies in Ethiopia[6,18] where no β-lactams and macrolides drug resistant was reported. These findings indicated that β-lactams and macrolides remain as the drug of choice for the treatment of GAS infection. It is known that erythromycin and clindamycin are usually used as an alternative treatment for patients allergic to penicillin. Fortunately in this study, no single isolate of GAS became resistant to erythromycin and clindamycin which was in agreement with findings elsewhere in Ethiopia,[6,18] Egypt[22] and Brazil.[27] However, various levels of resistance to erythromycin and clindamycin were reported in Turkey,[16] Tunisia[28] and China.[29] In the present study, 52.5% GAS isolates were resistant to tetracycline which was comparable with 68% reported in Ethiopia[6] and 50% in Brazil,[27] but much lower than 70% and 94% resistance rates documented in Tunisia[28] and China[29] respectively.

According to multivariate logistic regression analysis, absence of cough, presence of tonsillar swelling or exudate and body temperature $>38°$($P < 0.05$) were found to be independent predictors for GAS infection among children with pharyngitis. Similar findings were revealed in Canada,[30] USA[31–33] and Yemen.[24] However, it is important to know that the clinical variables that are predictor for GAS infection may vary with different GAS strains, geographic area and immunity profile of the study population.[22]

5. Conclusion

In this study the prevalence of GAS was relatively low. However, the seasonality of GAS infection might underestimate the prevalence, so that large-scale prospective study in the entire season and in various settings is required to understand the actual burden of infection. In our study, all GAS isolates remained susceptible to penicillins and macrolides indicating that those are still the drug of choice for the treatment of GAS infection in that locality. Furthermore, the clinical variables that are predictor of GAS pharyngitis can be considered for the diagnosis of GAS pharyngitis with further evaluation of its reproducibility in different settings.

Conflict of interest

None declared.

Acknowledgments

Authors would like to acknowledge Jimma University, Ethiopia for funding and children/their guardians/ for their willingness to participate in this study .

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